

City of Fremont

Baseline Greenhouse Gas Emissions
Inventory Report

June 2008



Conducted by ICLEI's Cities for Climate Protection® Campaign
in partnership with the City of Fremont

City of Fremont Baseline Greenhouse Gas Emissions Inventory

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Many thanks are also due to StopWaste.Org. Their generous support of ICLEI and the jurisdictions in Alameda County was instrumental to this project's success.

I. Introduction

Since the early 1990's scientific consensus holds that the world's population is releasing greenhouse gases faster than the earth's natural systems can absorb them. These gases are released as by-products of fossil fuel combustion, waste disposal, energy use, land-use changes, and other human activities. This release of gases, such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), creates a blanket around the earth that allows light to pass through but traps heat at the surface preventing its escape into space. Known as the greenhouse effect or global climate change, models show that this phenomenon will lead to a 2°F to 10°F temperature increase over the next 100 years. Already the Intergovernmental Panel on Climate Change warns that most of the warming observed over the last 50 years is attributable to human activities.

Changes in the earth's temperature will have impacts for residents of Fremont, California. These impacts could include:

- Increased heat waves
- Increased annual rainfall of 20 to 30 percent leading to more serious storm events
- Rising sea levels that will threaten coastal infrastructure, ecosystems, and water supplies
- Decrease in the Sierra snow pack that will effect fresh water availability and tourism opportunities
- Increase in insect born diseases

Although one city cannot independently resolve the issue of climate change, local governments can make a positive impact through cumulative local action. Cities and counties have the ability to reduce greenhouse gas emissions through effective land use and transportation planning, wise waste management, and the efficient use of energy.

A. Baseline Emissions Inventory Report: Purpose

This report presents the results of the City of Fremont's baseline greenhouse gas emissions inventory. The inventory was conducted by ICLEI – Local Governments for Sustainability in partnership with the City of Fremont. The purpose of the baseline emissions inventory is to determine the levels of greenhouse gas emissions that the City of Fremont emits in its base year, 2005, on a municipal operations level and a community-wide level. This information will be used to help the city adopt an emissions reduction target and develop an emissions reduction action plan. The inventory provides important information on the jurisdictions emissions profile so that subsequent emissions reduction strategies can be tailored to the community's specific situation.

B. The Alameda County Climate Protection Project

In December 2007 the City of Fremont, along with four other local governments in Alameda County, committed to becoming a member of ICLEI and participating in the Alameda County Climate Protection Project. The project was launched by ICLEI in partnership with StopWaste.Org and the Alameda County Conference of Mayors. In committing to the project, the City of Fremont embarked on an ongoing, coordinated effort to reduce the emissions that cause global warming, improve air quality, reduce waste, cut energy use and save money.

C. ICLEI and the Cities for Climate Protection Campaign

ICLEI's mission is to improve the global environment through local action. The Cities for Climate Protection® (CCP) Campaign is ICLEI's flagship campaign designed to educate and empower local governments worldwide to take action on climate change. ICLEI provides resources, tools, and technical assistance to help local governments measure and reduce greenhouse gas emissions in their communities and their internal municipal operations.

ICLEI's CCP Campaign was launched in 1993 when municipal leaders, invited by ICLEI, met at the United Nations in New York and adopted a declaration that called for the establishment of a worldwide movement of local governments to reduce greenhouse gas emissions, improve air quality, and enhance urban sustainability. The CCP Campaign achieves these results by linking climate change mitigation with actions that improve local air quality, reduce local government operating costs, and improve quality of life by addressing other local concerns. The CCP Campaign seeks to achieve significant reductions in U.S. greenhouse gas emissions by assisting local governments in taking action to reduce emissions and realize multiple benefits for their communities.

ICLEI uses the performance-oriented framework and methodology of the CCP Campaign's Five Milestones to assist U.S. local governments in developing and implementing harmonized local approaches for reducing global warming and air pollution emissions, with the additional benefit of improving community livability. The milestone process consists of:

- Milestone 1: Conduct a baseline emissions inventory and forecast
- Milestone 2: Adopt an emissions reduction target
- Milestone 3: Develop a Climate Action Plan for reducing emissions
- Milestone 4: Implement policies and measures
- Milestone 5: Monitor and verify results

In 2008 the City of Fremont adopted a resolution to take action for climate protection and officially joined ICLEI's Cities for Climate Protection Campaign.

II. Emissions Inventory

A. Reasoning, Methodology & Model

ICLEI's Cities for Climate Protection methodology enables local governments to systematically estimate and track greenhouse gas emissions from energy use and waste related activities at the community-wide scale and those resulting directly from municipal operations. The municipal operations inventory is a subset of the community-scale inventory.

Once completed, these inventories provide the basis for creating an emissions forecast and reduction target, and enable the quantification of emissions reductions associated with implemented and proposed measures.

1. Emissions Analysis Software

To facilitate local government efforts to identify and reduce greenhouse gas emissions, ICLEI developed the Clean Air and Climate Protection (CACP) software package in partnership with the State and Territorial Air Pollution Program Administrators (STAPPA), the Association of Local Air Pollution Control Officials (ALAPCO), and Torrie Smith Associates. This software estimates emissions derived from energy consumption and waste generation within a community. The CACP software determines emissions using specific factors (or coefficients) according to the type of fuel used. Emissions are aggregated and reported in terms of equivalent carbon dioxide units, or CO₂e. Converting all emissions to equivalent carbon dioxide units allows for the consideration of different greenhouse gases in comparable terms. For example, methane is twenty-one times more powerful than carbon dioxide in its capacity to trap heat, so the model converts one ton of methane emissions to 21 tons of CO₂e.

The emissions coefficients and methodology employed by the software are consistent with national and international inventory standards established by the Intergovernmental Panel on Climate Change (1996 Revised IPCC Guidelines for the Preparation of National GHG Emissions Inventories), the U.S. Voluntary Greenhouse Gas Reporting Guidelines (EIA form 1605), and, for emissions generated from solid waste, the U.S. EPA's Waste Reduction Model (WARM).

The CACP software has been and continues to be used by over 200 U.S. cities and counties to quantify the reduction in their greenhouse gas emissions. However, it is worth noting that, although the software provides cities/counties with a sophisticated and useful tool, calculating emissions from energy use with precision is difficult. The model depends upon numerous assumptions, and it is limited by the quantity and quality of available data. With this in mind, it is useful to think of any specific number generated by the model as an approximation, rather than an exact value.

2. Inventory Sources and Data Collection Process

An inventory of greenhouse gas emissions requires the collection of information from a variety of sectors and sources. For community electricity and natural gas data, ICLEI consulted Pacific Gas & Electric Company (PG&E). The Metropolitan Transportation Commission (MTC), CalTrans, Bay Area Air Quality Management District (BAAQMD), and Bay Area Rapid Transit (BART) served as sources of transportation data. Solid waste data was gathered from the California Integrated Waste Management Board Disposal Reporting System, <http://www.ciwmb.ca.gov/lgcentral/DRS/Reports/default.asp>.

Lori Marra and Kathy Cote, from the Environmental Services Division at the City of Fremont, coordinated the City's municipal data collection process. Aydin Zahner, Program Associate at ICLEI collected and analyzed the community-wide data.

These data were entered into the software to create a community emissions inventory and a municipal operations emissions inventory. The community inventory represents all the energy used and waste produced within the City of Fremont and its contribution to greenhouse gas emissions. The municipal inventory is a subset of the community inventory, and includes emissions derived from internal government operations.

There are two main reasons for completing separate emissions inventories for community and municipal operations. First, the government is committed to action on climate change, and has a higher degree of control to achieve reductions in its own municipal emissions than those created by the community at large. Second, by proactively reducing emissions generated by its own activities, the Fremont government takes a visible leadership role in the effort to address climate change. This is important for inspiring local action in Fremont as well as for inspiring other communities.

The City of Fremont's inventory is based on the year 2005. When calculating Fremont's emissions inventory, all energy consumed within the city limits was included with the exception of electricity and natural gas consumption in County-owned facilities. This means that, even though the electricity used by Fremont's residents is produced elsewhere, the energy and emissions associated with it appears in Fremont's inventory. The decision to calculate emissions in this manner reflects the general philosophy that a community should take full ownership of the impacts associated with its energy consumption, regardless of whether the generation occurs within the geographical limits of the community.

B. Inventory Results

The results below represent the City of Fremont's completion of the first milestone of ICLEI's CCP campaign.

1. Community Emissions Inventory

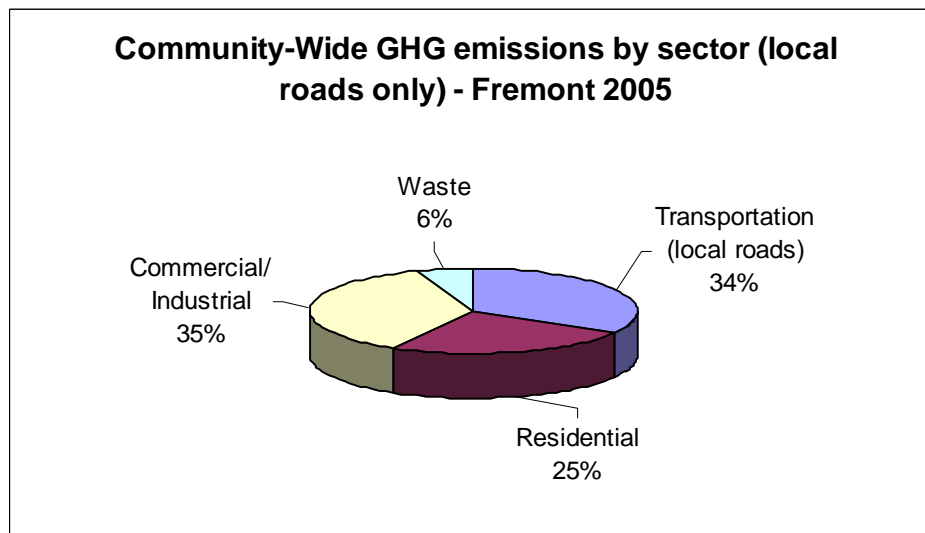
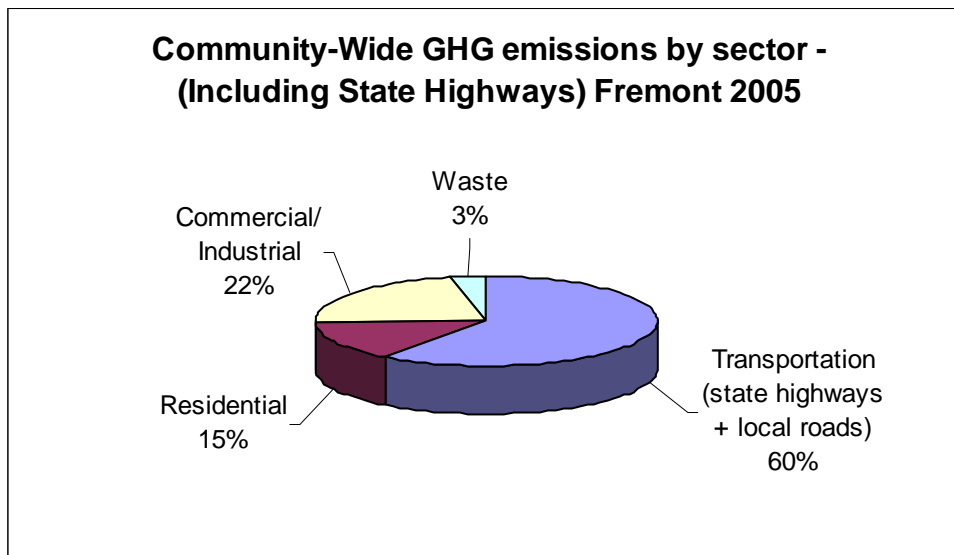
In the base year 2005, the City of Fremont emitted approximately 1,862,221 tons of CO₂e from the residential, commercial, industrial, transportation and waste sectors. Burning fossil fuels in vehicles and for energy use in buildings and facilities is a major contributor to Fremont's greenhouse gas emissions. Fuel consumption in the transportation sector is the single biggest source of emissions, contributing 60% of total emissions. Table (1) and Figure (a) below show Fremont's total greenhouse gas emissions from all major sources for the year 2005. The residential, commercial, and industrial sectors represent emissions that result from electricity and natural gas used in both private and public sector buildings and facilities. The transportation sector includes emissions from private, commercial and fleet vehicles driven within the City's geographical boundaries as well as the emissions from transit vehicles and the city-owned fleet.

Table (1): Fremont Community Emissions Summary

Potential Sources	Equiv CO ₂ e (tons)	Energy (MMBtu)
Residential	276,172	4,275,783
Commercial	397,122	5,905,652
Industrial	8,874	135,791
Transportation	1,116,412	13,660,857
Waste	63,641	0
TOTAL	1,862,221	23,978,083

Source: CACP Model output

Figure (a): Fremont Community Greenhouse Gas Emissions - Year 2005



Source: CACP Model output

Energy / Stationary Source Emissions

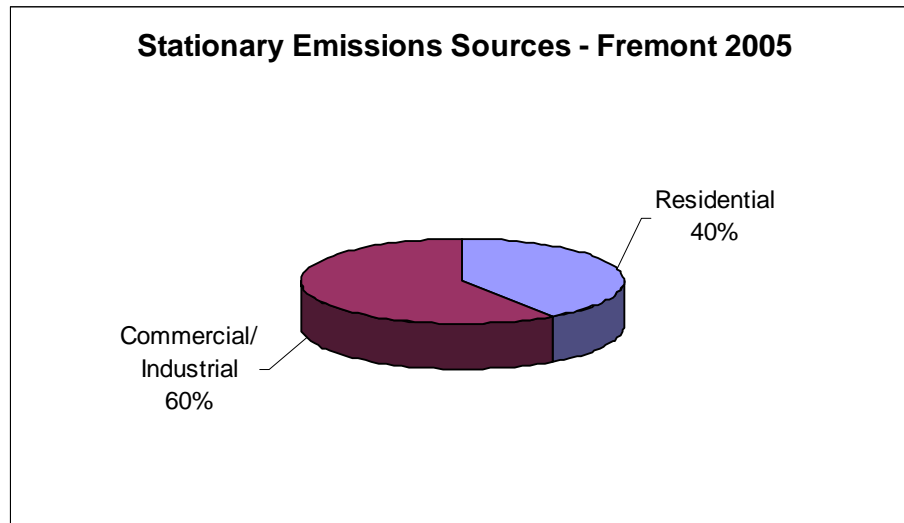
In 2005, Fremont's total stationary energy consumption was about 1,302,889,347 kWh of electricity and 58,705,048 therms of natural gas. Stationary energy use by all sectors (residential, commercial and industrial activities) accounts for 37% of total greenhouse gas emissions in Fremont. These emissions are a result of the combustion of fossil fuel. Fremont's stationary energy use resulted in a total of approximately 682,168 tons of CO₂e emissions in 2005.

The City of Fremont receives its electricity from Pacific Gas & Electric Company (PG&E). The 2005 emissions coefficients for electricity provided by PG&E are included in the notes in Appendix A (Data Summary Reports and Inventory Detailed Reports). The types of power sources that make up a utility's electricity generation mix have a significant impact on a city's greenhouse gas emissions. A coal fired

power plant, for example, releases 1.3 tons of CO₂e per megawatt-hour of electricity generated versus 0.7 tons for gas turbines and 0 tons for renewable sources such as solar, wind, or hydroelectric power.

Figure (b) shows the breakdown of greenhouse gas emissions by sector for both electricity and natural gas combined. Of the total 682,168 tons of CO₂e emitted due to stationary energy use, 40% was from residential buildings and 60% was from commercial/industrial buildings.

Figure (b): Fremont Community Greenhouse Gas Emissions Breakdown (Residential and Commercial/Industrial) - Year 2005



Source: CACP Model output

Residential

In 2005, Fremont's residents consumed 424,669,962 kWh of electricity and 28,263,975 therms of natural gas. This consumption resulted in a release of 276,172 tons of CO₂e. Major residential energy uses include refrigeration, lighting and water heating.

Commercial/Industrial

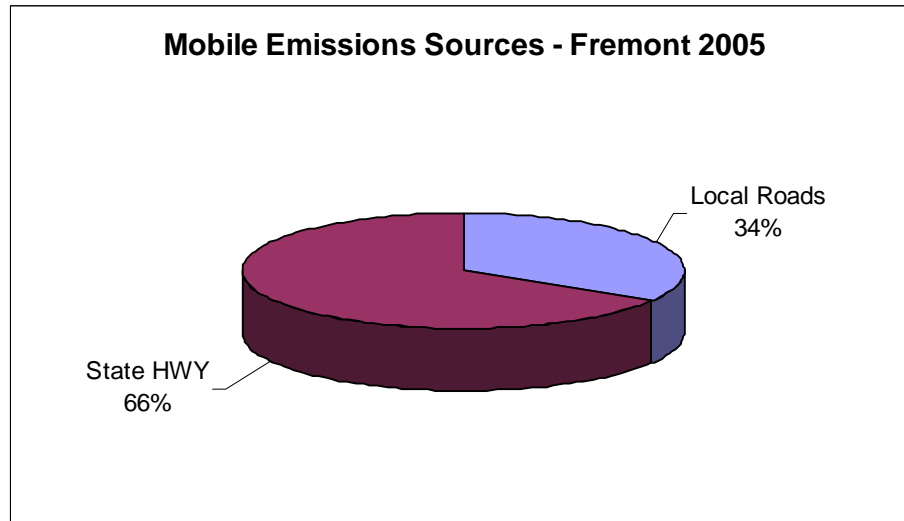
In 2005, Fremont's commercial/industrial sector buildings consumed 878,219,385 kWh of electricity and 30,441,073 therms of natural gas. This consumption resulted in a release of 405,996 tons of CO₂e into the atmosphere.

Transportation Emissions

When including vehicles on state highways and local roads, the transportation sector is responsible for about 60% of Fremont's greenhouse gas emissions. Motor vehicles driven within the City's geographical boundaries on both local and state roads emitted approximately 1,116,412 tons of CO₂e in 2005.

Figure (c) shows the breakdown of greenhouse gas emissions by VMT from local roads and VMT from state highways. Of the total 1,116,412 tons of CO₂e emitted due to stationary energy use, 34% was from local roads and 66% was from state highways.

Figure (c): Fremont Community Greenhouse Gas Emissions Breakdown (Local Roads and State Roads) - Year 2005



Calculations for transportation emissions are based on figures for total vehicle miles traveled (VMT) in the City of Fremont. MTC supplied the necessary VMT data, while BAAQMD provided data that enabled us to break down total VMT by percentage driven by a given vehicle type.

Solid Waste Emissions

In 2005, Fremont sent approximately 193,964 tons of solid waste to landfills resulting in 59,758 tons of CO₂e emissions. Fremont has recycling measures in place to reduce the amount of waste sent to landfills.

Emissions from waste result from organic materials decomposing in the anaerobic environment of a landfill which produces methane—a greenhouse gas 21 times more potent than carbon dioxide. Table (2) shows the approximate breakdown of the materials Fremont sent to landfills in 2005. Materials that do not release greenhouse gases as they decompose are included in the “All Other Waste” category.

Table (2): Fremont Waste Composition

Waste Type	Waste Share
Paper Products	22.4%
Food Waste	11.05%
Plant Debris	5.98%
Wood/Textiles	19.25%
All Other Waste	41.31%
Total	100%

Source: StopWaste.Org

Some landfills recover this methane either for energy generation or flaring converting it back into carbon dioxide. The EPA estimates that 60% to 80% of methane is recovered at the landfills to which Fremont sends its waste. Recent studies have begun to question the U.S. EPA’s estimates for the amount of methane that is actually captured by methane recovery systems at landfills. Many hypothesize that the efficiency with which methane recovery systems capture methane is currently overestimated, and that much more of the potent greenhouse gas is actually escaping from landfills into the atmosphere. In the absence of exact data, the Inter-governmental Panel on Climate Change recommends using the

conservative end of that range to estimate the percentage of methane recovery at landfills. ICLEI chose to follow the recommendation and used a 60 percent methane recovery factor for Fremont's inventory.

The CACP software calculates emissions from waste disposal using a model based on the U.S. EPA's Waste Reduction Model (WARM) and is therefore consistent with national standards. The CACP software is designed to follow EPA guidelines regarding methane recovery and the tool will be updated appropriately as guidelines change.

Recycling and composting programs are reflected in the CACP software model as reduced total tonnage of waste going to the landfills. The CACP model, however, does not accurately capture the associated emissions reductions in "upstream" energy use from recycling. Despite this limitation, *recycling and composting programs can have a significant impact on GHG emissions*. Manufacturing products with recycled materials avoids emissions from the energy that would have been used during extraction, transporting and processing of virgin raw materials. Recycling paper also conserves forests, which contribute to carbon sequestration – a process that removes carbon from the atmosphere and stores it for long periods of time. Recycling plastic reduces the need for the oil needed to produce new plastics. For example, if Fremont recycled an additional 20,000 tons of waste, then the City would reduce CO₂e emissions by another 53,000 tons.

2. Municipal Operations Emissions Inventory

ICLEI's emissions analysis software and methodology enable a jurisdiction to inventory the emissions that result from municipal operations. As was noted earlier, the municipal inventory is a subset of the community inventory.

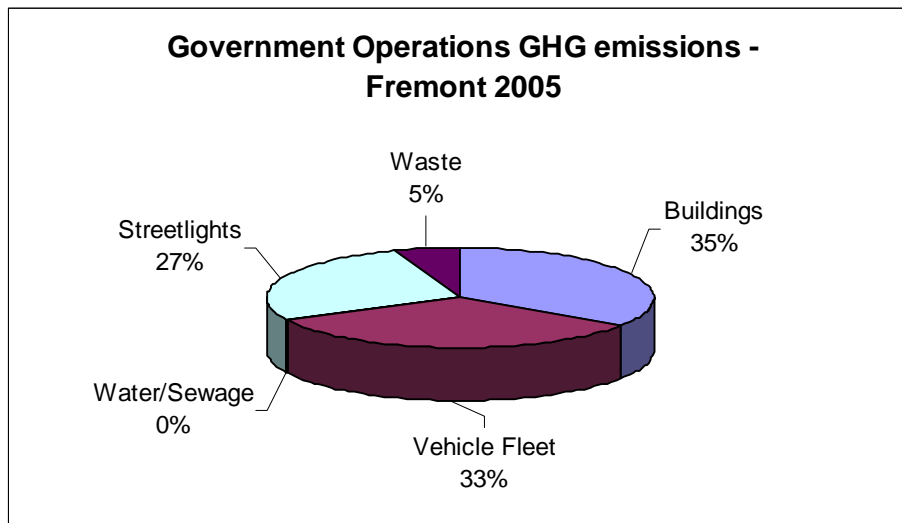
In the base year of 2005, Fremont's municipal operations generated 8,449 tons of CO₂e. As Table (3) and Figure (d) show, the City's buildings accounted for the majority of emissions, followed by vehicle fleet.

Table (3): Fremont Municipal Emissions Summary

Potential Sources	Equiv CO ₂ e (tons)	Energy (MMBtu)
Buildings	2,907	43,091
Vehicle Fleet	2,789	32,564
Streetlights	2,262	29,930
Water/Sewage	33	443
Waste	458	0
TOTAL	8,449	104,863

Source: CACP Model output

Figure (d): Fremont Municipal Greenhouse Gas Emissions – Year 2005



Source: CACP Model output

Municipal emissions in Fremont constitute about .5% of Fremont's total emissions. Local government emissions typically fall between one and five percent of overall community emissions. Appendix B shows the results of the CACP analysis. As a minor contributor to total emissions, actions to reduce municipal energy use may have a limited impact on Fremont's overall community emissions levels. However, municipal action can help reduce operation costs and has symbolic value demonstrating leadership that extends beyond the magnitude of emissions actually reduced.

Energy/Stationary Source Emissions

In 2005, Fremont municipal buildings, facilities, streetlights, and water distribution consumed 15,365,558 kWh of electricity and 210,214 therms of natural gas, which resulted in a release of 5,202 tons of CO₂e emissions into the atmosphere.

Transportation Emissions

The City's vehicle fleet consumed approximately 204,864 gallons of gasoline and 56,000 gallons of diesel emitting about 2,789 tons of CO₂e. The municipal fleet includes all vehicles owned and operated by the City of Fremont plus some contractor vehicles performing City functions.

Solid Waste Emissions

The City of Fremont government operations reported sending 2286 tons of waste to the landfill resulting in 458 tons of CO₂e according to method described above. The city does have recycling programs in place to reduce waste stream.

III. Forecast for Greenhouse Gas Emissions

Based on the community and municipal operations emissions inventories developed for Fremont for the base year 2005, the next step was to forecast future emissions for the year 2020. The emission forecast represents a business-as-usual prediction of how greenhouse gas (GHG) emissions may change in the City of Fremont over time for the community sector.

The forecast projects the growth (or reduction) in greenhouse gas emissions that will occur in a given future year. Projections are based on the assumption that energy consumption will grow as population increases. For the community analysis, the forecast was conducted by applying population growth factors to Fremont's base year residential, commercial/industrial, and transportation data resulted in a forecast of 14% growth in emissions based on a business-as-usual scenario. For the municipal government analysis, no growth was anticipated in the municipal government operations. Table (4) provides an emissions summary for Fremont's base year and forecast year.

Table (4): Fremont's Emissions Summary

Fremont's Emissions Summary		
	Community Analysis	Municipal Operations Analysis
Base year	2005	2005
Indicators used to generate forecast	.765% (Annual population growth rate based on ABAG data)	No growth anticipated
Quantity of CO ₂ e emissions in base year (tons)	1,798,580	7,761
Forecast year	2020	2020
Business-as-usual projection of CO ₂ e emissions in 2020 (tons): 14% increase over baseline	2,085,141	7,761

Source: CACP Model Output and ABAG

Conducting an emissions forecast is essential for setting an emissions reduction target, since the amount of GHG emissions Fremont pledges to reduce will be derived from projected emissions. Appendix C provides the results of the CACP analysis.

IV. Conclusion

This baseline greenhouse gas emissions inventory report represents a profile of the greenhouse gases that the City of Fremont emits in its base year, 2005, on a community-wide level and a municipal level. The report also approximates the greenhouse gases that the City will emit in the year 2020.

This information will be used to help the City adopt an emissions reduction target and develop a climate action plan. The climate action plan consists of policies and measures that, when implemented, will serve the City to achieve its target. The inventory also serves to inform the City regarding the major sources of greenhouse gas emissions. For example, the community-wide inventory for the City of Fremont reveals that the transportation sector is responsible for 60% of total emissions.

The inventory also reveals the fact that in Fremont, like all cities, the municipal government emissions represent a small percentage of community-wide emissions, in this case less than one percent. That being said, by proactively reducing emissions generated by its own activities, the Fremont government takes a visible leadership role in the effort to address climate change. This is important for inspiring local action in Fremont as well as for inspiring action in other communities.

Appendix A – CACP Reports by Sector, Data Sources, Assumptions and Notes for the Community Inventory

See PDF file, Appendix A_Fremont Community-Wide CACP Reports.pdf

Appendix B – CACP Reports by Sector, Data Sources, Assumptions and Notes for the Municipal Inventory

See PDF file, Appendix B_Fremont Government Operations CACP Reports.pdf

Appendix C – CACP Summary Report for the Community Emissions Forecast

See PDF file, Appendix C_Fremont Community-Wide CACP Forecast Report.pdf